भारतीय मानक
Indian Standard

IS 17046 : 2018
(Reaffirmed 2021)

टीवी केबलों के अनुप्रयोग के लिए रेशा और रेशा तंतु केबलें

Fibre Optic Cable for Cable TV Application

ICS 33.180

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भारतीय मानक ब्यूरो
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November 2018 **Price Group 5**

Fibre Optics, Fibres, Cables and Devices Sectional Committee, LITD 11

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Fibre Optics, Fibres, Cables and Devices Sectional Committee and had been approved by the Electronics and Information Technology Division Council.

Presently there is no ISO/IEC Standard on this subject. However, this standard has been derived from TEC GR No. TEC/GR/TX/OFC-024/01/MAR-15 for ‘Aerial drop optical fibre cable’ (for last mile application) as a cost effective solution for short spans.

The object of this standard is to lay down the material requirement, design and constructional requirements, installation details and methods of tests for fibre and fibre optic cable to be installed aerially by service providers like Multiple Service Operators (MSO) for cable TV and broad-band application.

Fibre and fibre optic cable to be used by service providers like Multiple Service Operator, is the new variety of cables to be used in the cable TV network and other similar type of applications replacing co-axial cables which is being used now and has many advantages over co-axial cables including cost effectiveness.

The composition of the Committee responsible for the formulation of this standard is given in Annex D

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

FIBRE OPTIC CABLE
FOR CABLE TV APPLICATION

1 SCOPE

This standard defines the requirements of fibre and outdoor fibre optic drop cable deployed aerially for the applications like Cable TV, Broadband, etc. and typically to be used by the service providers like Multiple Service Operator (MSO), local cable operators, etc.

2 REFERENCES

The standards listed in Annex B and Annex C contains provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex B and Annex C.

3 GENERAL REQUIREMENTS

3.1 The design and construction of aerial metal free optical fibre cable shall be inherently robust and rigid under all conditions of installation, operation, adjustment, replacement, storage and transport.

3.2 The fibre used in the cable shall be as per ITU-T G.652 D.

3.3 The self-supporting metal free aerial optical fibre cable shall be designed and manufactured to meet the following conditions of operation, installation and storage :

- a) Maximum pan length : 50 m
- b) Operational wind velocity : 50 Km/h
- c) Sag of the span length:-
  - 1) Maximum sag allowed without excess load : 1 percent of the span length
  - 2) Maximum sag allowed with excess load : 3 percent of the span length

3.4 Technical Requirements

Single mode optical fibre is used in manufacturing optical fibre cables shall be as per ITU-T Rec. G 652D. The specification of optical fibre is mentioned below.

3.4.1 *Geometrical Characteristics*

- a) Mode field diameter (MFD) at 1 310 nm : [8.8 to 9.2] µm; tolerance : ± 0.6 µm
- b) Cladding diameter : 125 µm ± 0.7µm
- c) Cladding non-circularity : ≤ 0.8 percent
- d) Core clad concentricity error : ≤ 0.5 µm
- e) Diameter over primary coated with (Color) double UV cured acrylate : 242 µm ± 10 µm (Uncolor); 252 µm ± 10 µm
- f) Coating/cladding concentricity : ≤ 12 µm

3.4.2 *Transmission Characteristics:*

Cabled fibre attenuation:

- a) At 1 310 nm : ≤0.36 dB/km
- b) At 1 383 nm : ≤0.36 dB/km
- c) At 1 550 nm : ≤0.23 dB/km

NOTE — Point discontinuity in attenuation shall be less than 0.1 dB at 1 310 nm and 1 550 nm.

3.4.3 *Dispersion:*

- a) Chromatic Dispersion :
  - 1) In 1 285-1 330 nm band : ≤ 3.5 ps/nm.km
  - 2) In 1 270-1 340 nm band : ≤ 5.3 ps/nm.km
  - 3) At 1 550 nm. : ≤ 18.0 ps/nm. km
  - 4) At 1 625 nm. : < 22.0 ps/nm.km
  - 5) Zero dispersion slope : ≤ 0.090 ps/(nm^2 km)
  - 6) Zero dispersion wave length range : 1 300-1 324 nm
- b) Polarization mode dispersion
  - 1) Individual cabled fibre : ≤ 0.3 ps/$\sqrt{\text{km}}$
  - 2) Link design value : ≤0.2 ps/$\sqrt{\text{km}}$

3.4.4 *Cable Cut off Wavelength* : ≤ 1 260 nm

3.5 Mechanical Characteristics:

3.5.1 *Proof Test for Minimum Strain Level* : 1 percent

(Test method IS/IEC-60793-1-30:2010)

3.5.2 *Peak Strippibility Force to Remove Primary Coating of the Fibre (Test Method IS/IEC-60793-1-32 : 2010)* : 1.3 ≤ F ≤ 8.9 N

3.5.3 *Dynamic Tensile Strength*
(Test method IS/IEC- 60793-1-31 : 2010)

a) *Un-aged (Median value)* : ≥ 550 KPSI (3.80 GPa)
b) *Aged (Median value)* : ≥ 440 KPSI (3.00 GPa)

3.5.4 *Dynamic Fatigue* : ≥ 20

3.5.5 *Static Fatigue*
(Test Method IS/IEC 60793-1-33 : 2001) : ≥ 20

3.5.6 *Fibre Curl*
(Test Method IS/IEC 60793-1-34 : 2006) : ≥ 4 M

3.6 Environmental Characteristic of Fibre

3.6.1 *Operating Temperature*
(Test method IS/IEC 60793-1-1 : 2008)
Temperature dependence of attenuation : –60°C to +85°C
Induced attenuation at 1 310 nm and 1 550 nm at -60°C to +85°C : ≤ 0.05 dB/km

3.6.2 *Temperature — Humidity Cycling*
(Test Method IS/IEC 60793-1-1 : 2008)
Induced attenuation at 1 310 nm and 1 550 nm at –10°C to +85°C and 95percent relative humidity. : ≤ 0.05 dB/km

3.6.3 *Water Immersion*
(Test Method IS/IEC 60793-1-1 : 2008)
Induced attenuation at 1 310 nm and 1 550 nm due to Water immersion at 23 ± 2°C : ≤ 0.05 dB/km

3.6.4 *Accelerated Aging (Temperature)*
(Test Method IS/IEC 60793-1-1 : 2008)
Induced attenuation at 1 310 nm and 1 550 nm due to Temperature aging at 85 ± 2°C : ≤ 0.05dB/km

3.7 Optical Fibre Cable Construction Specifications

The cable shall be designed to the parameters mentioned in Annex A. The manufacturer shall submit designed calculation and the same shall be studied and checked.

3.7.1 *Secondary Protection (Buffer Tube)*

The primary coated colored fibres shall be protected by loose packaging within a tube which shall be filled with thixotropic jelly. In case of 24 F two bundles of 12 F each shall be wrapped with the binders of different colors that is Blue and Orange.

3.7.2 *Number of Fibres* : 12 and 24

3.7.3 *Reinforcement*

The cable shall be reinforced with aramid yarn in the periphery over the loose tube. The aramid yarn shall be uniformly and equally distributed on the entire periphery (circumference) of the buffer tube. The quantity of the aramid yrn used per kilometer length of the cable with its D-Tex value shall be as per requirement in Annex A.

3.7.4 *Filling Compound*

The filling compound used in the buffer tube shall be compatible to fibre, secondary protection of fibre etc. The drip point shall not be lower than +70° C. The fibre movement shall not be constrained by stickiness and shall be easily removable for splicing. The test method to measure drop point shall be as per ASTM D 556.

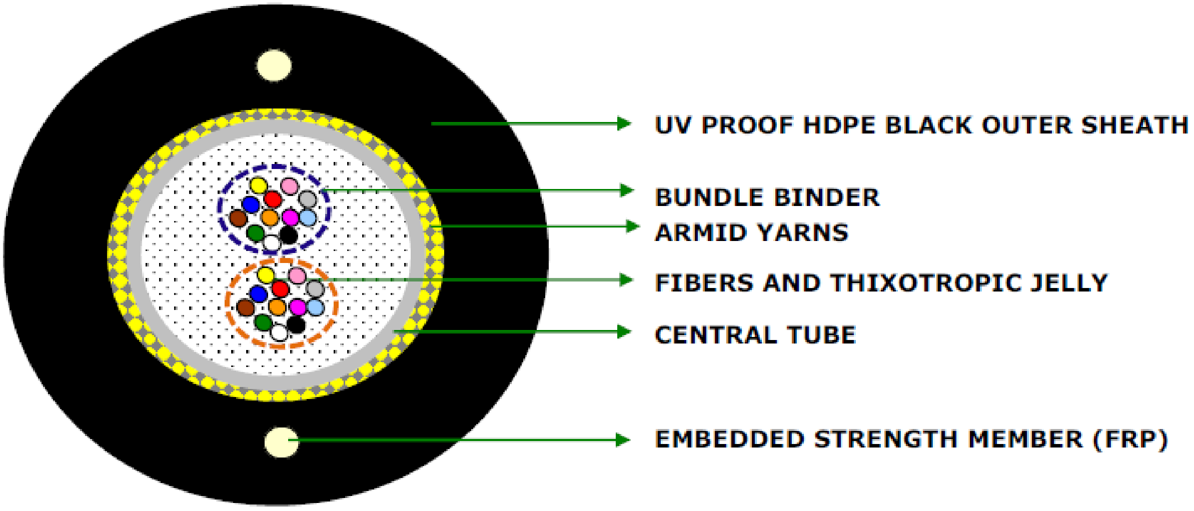
UV PROOF HDPE BLACK OUTER SHEATH
BUNDLE BINDER
ARMID YARNS
FIBERS AND THIXOTROPIC JELLY
CENTRAL TUBE
EMBEDDED STRENGTH MEMBER (FRP)

Fig. 1 Typical Structural Drawing for 24 Fibre of Cable

3.7.5 *Outer Jacket*

A circular and uniform tough weather resistant UV Stabilized polyethylene compound HDPE material sheath/Jacket, black in colour, shall be provided over and above the reinforcement of aramid yarn. The thickness of the outer sheath/Jacket shall be minimum 1.8 mm. The sheath shall be free from pin holes, joints, scratches, mended pieces and other defects etc. and it shall have smooth finish.

3.7.6 *Strength Member (Embedded)*

Solid fiberglass-reinforced plastics (FRP) non-metallic strength member embedded in the outer jacket. The strength member in the cable shall be for strength and flexibility of the cable and shall have anti buckling properties. This shall also keep the fibre strain within permissible values.

3.7.7 *Cable Parameter*

The manufacturer shall define all the cable parameters. The parameters of finished cable shall be as per Annex A.

3.8 Mechanical Characteristics and Tests on Optical Fibre Cable

3.8.1 *Tensile Strength Test*

3.8.1.1 *Objective*

To test the tensile strength of self-supporting metal free aerial optical fibre cable, in order to examine the behavior of the attenuation as a function of the load on a cable. This load occurs during installation, while the aerial optical fibre cable encounters the excess ice loading and the winds at high speed.

3.8.1.2 *Method*

IS/IEC 60794-1-2 : 2003.

3.8.1.3 *Test specs*

The cable shall have sufficient strength to withstand a load of value T(N) = 9.81 × 1.5 W Newton (where, W-mass of 1 Km of cable, in Kg) or 600 N whichever is higher". The load shall be sustained for 10 min and the strain on the fibre and the attenuation shall be monitored.

3.8.1.4 *Requirement*

The load shall not produce a strain exceeding 0.33 percent in the fibre and shall not cause any permanent physical or optical damage to any component of the cable. The attenuation shall be noted before strain and after the release of strain. The change in attenuation of each fibre after the test shall be $\leq$ 0.05 dB, both for 1 310 nm and 1 550 nm wavelength.

3.8.2 *Crush Test (Compressive Test)*

3.8.2.1 *Objective*

The purpose of this test is to determine the ability of an optical fibre cable to withstand crushing.

3.8.2.2 *Method*

IS/IEC 60794-1-2:2003

3.8.2.3 *Test specs*

The fibres and component parts of the cable shall not suffer permanent damage when subjected to a compressive load of 2 000 Newton applied, between the plates of dimension 100 × 100 mm. The load shall be applied for 60 s. The attenuation shall be noted before and after the completion of the test.

3.8.2.4 *Requirement*

The change in attenuation of the fibre after the test shall be $\leq$ 0.05 dB, both for 1 310 nm and 1 550 nm wavelength.

3.8.3 *Impact Test*

3.8.3.1 *Object*

The purpose of this test is to determine the ability of an optical fibre cable to withstand impact.

3.8.3.2 *Method*

IS/IEC 60794-1-2 : 2003

3.8.3.3 *Test specs*

The cable shall have sufficient strength to withstand an impact caused by a mass weight of 25 Newton, when falls freely from a height of 0.5 meters. The radius R of the surface causing impact shall be 300 mm. Ten such impacts shall be applied at the same place. The attenuation shall be noted before and after the completion of the test.

3.8.3.4 *Requirement*

The change in attenuation of the fibre after the test shall be $\leq$ 0.05 dB both for 1 310 nm and 1 550 nm wavelength.

3.8.4 *Repeated Bending*

3.8.4.1 *Objective*

The purpose of this test is to determine the ability of an optical fibre cable to withstand repeated bending.

3.8.4.2 *Method*

EIA-455-104.

3.8.4.3 *Test specs*

The cable sample shall be of sufficient length (5 m minimum) to permit radiant power measurements as required by this test. Longer lengths may be used, if required.

Parameters :

Weight	: 5 Kg
Minimum distance from pulley centre to holding device	: 216 mm
Minimum distance from Wt. to pulley centre	: 457 mm
Pulley diameter	: 20D (D–cable diameter)
Angle of turning	: 90°
No. of cycles	: 30
Time required for 30 cycles	: 2 min

3.8.4.4 *Requirement*

During the test no fibre shall break and the attenuation shall be noted before and after the completion of the test. The change in attenuation of the fibre after the test shall be $\leq$ 0.05 dB, both for 1 310 nm and 1 550 nm wavelength

3.8.5 *Torsion Test*

3.8.5.1 *Object*

The purpose of this test is to determine the ability of an optical fibre cable to withstand torsion.

3.8.5.2 *Method*

IS/IEC 60794-1-2:2003

3.8.5.3 *Test specs*

The length of the specimen under test shall be 2 meters and the load shall be 50N. The sample shall be mounted in the test apparatus with cable clamped in the fixed clamp, sufficiently tight, to prevent the movement of cable sheath during the test. One end of the cable shall be fixed to the rotating clamp, which shall be rotated in a clock wise direction for one turn.

The sample shall then be returned to the starting position and then rotated in an anti-clock wise direction for one turn and returned to the starting position. This complete movement constitutes one cycle. The cable shall withstand ten such complete cycles. The attenuation shall be noted before and after the completion of the test.

3.8.5.4 *Requirement*

The cable shall be examined physically for any cracks, tearing on the outer sheath and for the damage to other component ports of the cable. The twist mark shall not be taken as damage. The change in attenuation of the fibre after the test shall be $\leq$ 0.05 dB, both for 1 310 nm and 1 550 nm wave length.

3.8.6 *Cable Bend Test*

3.8.6.1 *Objective*

The purpose of this test is to determine the ability of an optical fibre cable to withstand repeated flexing. The procedure is designed to measure optical transmittance changes and requires an assessment of any damage occurring to other cable components.

3.8.6.2 *Method*

IS/IEC 60794-1-2 : 2003 (Procedure-I)

3.8.6.3 *Test specs*

The fibre and the component parts of the cable shall not suffer permanent damage when the cable is repeatedly wrapped and unwrapped 4 complete turns of 10 complete cycles around a mandrel having diameter of 20 D, where D is the diameter of the cable. The attenuation shall be noted before and after the completion of the test.

3.8.6.4 *Requirement*

The change in attenuation of the fibre after the test shall be $\leq$0.05 dB, both for 1 310 nm and 1 550 nm wavelength. Sheath shall not show any cracks visible to the naked eye, when examined whilst still wrapped on the mandrel.

3.8.7 *Temperature Cycling*

3.8.7.1 *Objective*

To determine the stability behavior of the attenuation of a cable subjected to temperature changes, which may occur during storage, transportation and usage.

3.8.7.2 *Method*

IEC 60794-1-2-F1. (To be tested on Standard cable length of drum)

3.8.7.3 *Test specs*

The permissible temperature range of the cable for storage shall be from –20°C to +70°C and for operation –20°C to +70°C. The rate of change of temperature during the test shall be 1° per minute approx. The cable shall be subjected to temperature cycling for 12 h at each temperature as given below:

T_{A2} temp. :	– 20°C
T_{A1} temp. :	– 10°C.
T_{B1} temp. :	+ 60°C.
T_{B2} temp. :	+ 70°C.

The test shall be conducted for 2 cycles at the above temperatures.

3.8.7.4 *Requirement*

The change in attenuation of the fibre under test shall be $\leq$ 0.05 dB, both for 1 310 nm and 1 550 nm wave length for the entire range of temperature.

3.8.8 *Colour Coding Scheme*

a) Cable with fibres up to 12 fibres :

The individual optical fibre shall be colour coded as follows:

Table 1

Sl No. (1)	Fibre No. (2)	Fibre Colour (3)
i)	1	Blue
ii)	2	Orange
iii)	3	Green
iv)	4	Brown
v)	5	Slate
vi)	6	White
vii)	7	Red
viii)	8	Black
ix)	9	Yellow
x)	10	Violet
xi)	11	Rose/Pink
xii)	12	Aqua

b) Cable with more than 12 fibres

In a cable with more than 12 fibres count, each bundle of 12 fibres shall be identified by use of colour coded bundle binders and the colour scheme shall be as per Table 2 while fibres color coding shall be as per **5.4.2.**

4 MARKING

4.1 The cable shall carry the following information either stenciled on the reel or drum or contained in a label attached to it:

a) Reference to this Indian Standard;
b) Manufacturer's name, brand name or trademark;
c) Type of cable,
d) Length of cable on the reel, drum or coil; and
e) Number of lengths on the reel, drum or coil (if more than one).

4.2 BIS Certification Marking

The cable may also be marked with the Standard Mark.

4.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulation made thereunder. The details of the conditions under which the licence for use of the Standard Mark may be granted to manufacturers and producers may be obtained from the Bureau of Indian Standards.

Table 2

Sl No. (1)	Number of Fibres in a Cable (2)	Number of Fibre/ Bundles (3)	Number of Bundles (4)	Colour of Bundle Binder (5)
i)	24 Fibres	12	Two	Blue and Orange

ANNEX A

(*Clause* 3.7)

Cable Parameters

The following parameters of the component parts of the cable are to be taken into account while designing and manufacturing the optical fibre cables of the required fibre count. These parameters shall be checked during evaluation of the of cables.

Sl No.	Parameter	Unit	Design Type	
1	Fibre Count	No.	12	24
2	Fibre Per Tube	No.	12	24
3	Fibre Color		Blue, orange, green, brown, slate, white, red, black, yellow, violet, pink, aqua.	**Bundle 1 (Blue Binder) —** Blue, orange, green, brown, slate, white, red, black, yellow, violet, pink, aqua **Bundle 2 (Orange Binder) —** Blue, orange, green, brown, slate, white, red, black, yellow, violet, pink, aqua
4	Tube Internal Diameter	mm	1.4 +/– 0.2	2.0 +/– 0.2
5	Tube Outer Diameter	mm	2.0 +/– 0.1	3.0 +/– 0.1
6	Loose Tube Color		Natural	Natural
7	Loose Tube Material		PBT	PBT
8	Embedded Strength Member Material		FRP	FRP
9	Diameter of FRP (Embedded Strength Member)	mm	1.0 + 0.1	1.0 + 0.1
10	Aramid Yarns (Peripheral Strength Member)	Kg/Km	Minimum 1.9	Minimum 2.2
11	Sheath Material		UV Proof HDPE	UV Proof HDPE
12	Colour of Sheath Material		Black	Black
13	Thickness of Sheath Material (Minimum)	mm	1.8	1.8
14	Cable Weight	Kg/Km	38 + 10percent	46 + 10percent
15	Cable Diameter	mm	6.5 + 0.5	7.5 + 0.5

ANNEX B

(*Clause 2*)

LIST OF REFFERED INDIAN STANDARDS

IS No.	*Title*
IS/IEC 60793-1-1 : 2008	Optical fibres: Part 1 Measurement methods and test procedures, Section 1 General and guidance
IS/IEC 60793-1-30 : 2010	Optical fibres: Part 1 Measurement methods and test procedures, Section 30 Fibre proof test
IS/IEC 60793-1-31 : 2010	Optical fibres: Part 1 Measurement methods and test procedures, Section 31 Tensile strength
IS/IEC 60793-1-32 : 2010	Optical fibres: Part 1 Measurement methods and test procedures, Section 32 Coating strippability
IS/IEC 60793-1-33 : 2001	Optical fibres: Part 1 Measurement methods and test procedures, Section 33 Stress corrosion susceptibility
IS/IEC 60793-1-34 : 2006	Optical fibres: Part 1 Measurement method and test procedures, Section 34 Fibre curl
IS/IEC 60793-1-47 : 2009	Optical fibres: Part 1 Measurement methods and test procedures, Section 47 Mocrobending loss
IS/IEC 60794-1-2 : 2003	Optical fibre cables: Part 1 Generic specification, Section 2 Basic optical cable test procedures

ANNEX C

(*Clause 2*)

LIST OF REFERRED INTERNATIONAL STANDARDS

International Standards/ Other Publication	*Title*
ITU-T Rec. G.652 D	Characteristics of a single-mode optical fibre and cable
EIA-455-104	Fibre optic cable cyclic — Flexing test
IEC 60794-1-21	Optical fibre cables — Part 1-21: Generic specification — Basic optical cable test procedures — Mechanical tests methods
IEC 60794-1-22	Optical fibre cables — Part 1-22: Generic specification — Basic optical cable test procedures — Environmental tests methods

ANNEX D

(*Foreward*)

COMMITTEE COMPOSITION

Fibre Optics, Fibres, Cables And Devices Sectional Committee, LITD 11

Organization	*Representative(s)*
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Component Approval Centre Telecommunication, Bengaluru	Nomination Awaited
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Organization	*Representative(s)*
In Personnel Capacity, New Delhi	Shri A. K. Kansal
Director General, BIS	Mrs Reena Garg, Scientist 'F' and Head (LITD) [Representing Director General (*Ex-officio*)]

Member Secretary

Shri Bipin Jambholkar
Scientist 'C' (LITD), BIS

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: LITD 11 (10337).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Published by BIS, New Delhi